

Development of Advanced Manufacturing Methods for Warm-White LEDs for General Lighting



DOE Project # DE-EE0003232

**Project update at the SSL Manufacturing workshop in San Jose, CA
13th-14th June 2012**

Team at GE Lighting Solutions

Anirudha Deshpande (PI), Boris Kolodin, Cherian Jacob, Ashfaul Chowdhury, Glenn Kuenzler, Danny Aesram, Steven Glaettli, Brian Gallagher, Paul Langer

Advisory role – Anant Setlur, William Beers



imagination at work

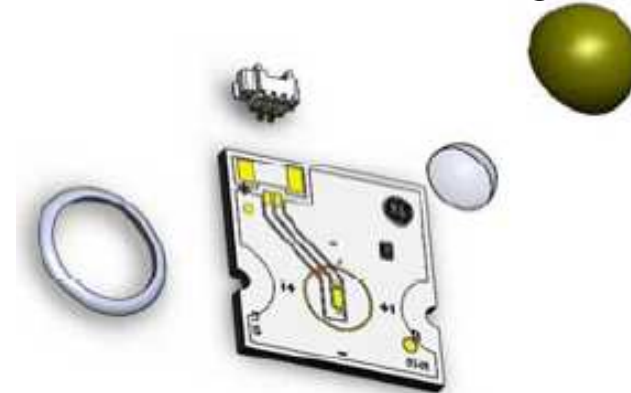
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Background for the project

Vio™ Designed for performance, ease of manufacturing and scalability



Vio Nomenclature

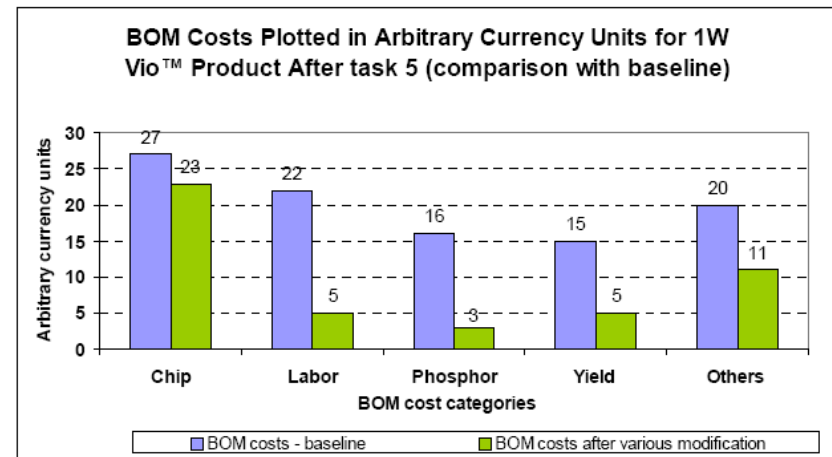


Data Sheet

Electrical and Optical Performance

Part Number	Description	CRI	CCT Min.	CCT Typical	CCT Max.	Watts	Lumens Typical	Lumens per Watt Typical	Forward Voltage (Vf) Min.	Forward Voltage Typical	Forward Voltage (Vf) Max.
73357	Vio/1.2W/730	70	2800	3000	3200	1.2	64	53	3.2	3.5	4
73355	Vio/1.2W/735	70	3300	3500	3700	1.2	67	55	3.2	3.5	4
73353	Vio/1.2W/741	70	3900	4100	4300	1.2	69	57	3.2	3.5	4
73351	Vio/1.2W/830	85	2800	3000	3200	1.2	55	45	3.2	3.5	4
73349	Vio/1.2W/835	85	3300	3500	3700	1.2	55	45	3.2	3.5	4
73347	Vio/1.2W/841	85	3900	4100	4300	1.2	57	47	3.2	3.5	4
73356	Vio/3.6W/730	70	2800	3000	3200	3.6	171	48	9.6	10.2	12
73354	Vio/3.6W/735	70	3300	3500	3700	3.6	188	53	9.6	10.2	12
73352	Vio/3.6W/741	70	3900	4100	4300	3.6	196	55	9.6	10.2	12
73350	Vio/3.6W/830	85	2800	3000	3200	3.6	142	40	9.6	10.2	12
73348	Vio/3.6W/835	85	3300	3500	3700	3.6	153	43	9.6	10.2	12
73346	Vio/3.6W/841	85	3900	4100	4300	3.6	160	45	9.6	10.2	12
74759	Vio/7.2W/730	70	2800	3000	3200	7.2	300	44	18	20	22
74760	Vio/7.2W/735	70	3300	3500	3700	7.2	350	52	18	20	22
74761	Vio/7.2W/741	70	3900	4100	4300	7.2	330	49	18	20	22
74762	Vio/7.2W/830	85	2800	3000	3200	7.2	250	36	18	20	22
74763	Vio/7.2W/835	85	3300	3500	3700	7.2	275	41	18	20	22
74764	Vio/7.2W/841	85	3900	4100	4300	7.2	285	42	18	20	22

5 second pulse (all data measured at T_b = 25°C, I_f = 350 mA)



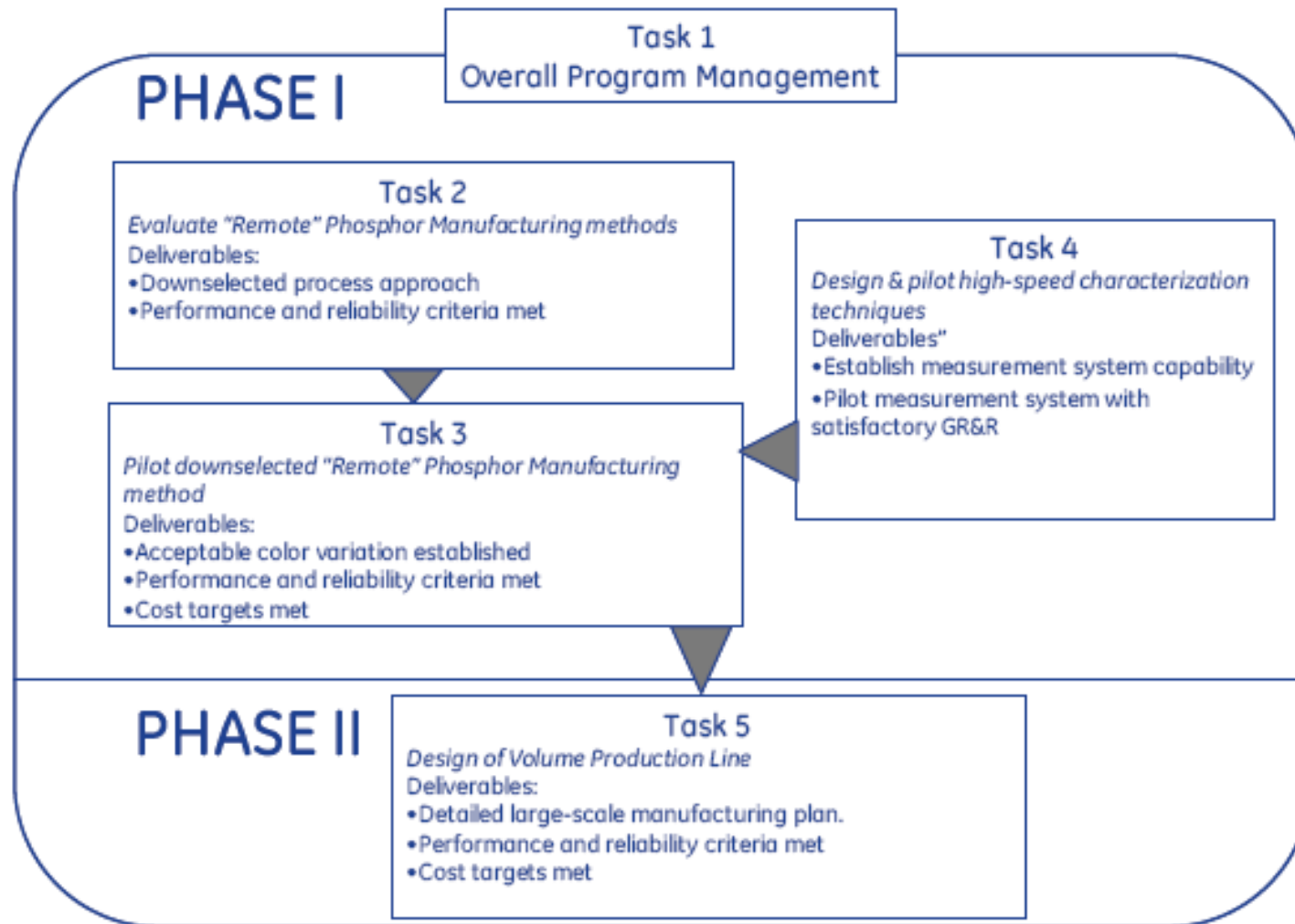
- Established product with a range of different SKUs (1W-7W)
- Potential for manuf. cost reduction and performance improvement



imagination at work

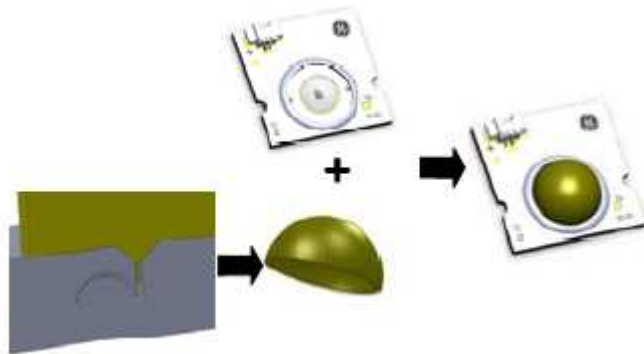
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Project Plan



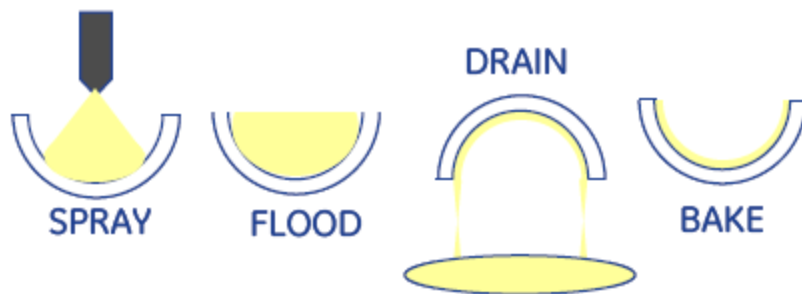
Task-2

Phosphor molding



OR

Slurry Coating



Milestone # 1

Based on early reliability /
performance / cost savings potential
– **Phosphor Molding** selected as
the preferred path

- Eliminate phosphor waste in current process
- Reduce part to part color variation

Task 2

Evaluate "Remote" Phosphor Manufacturing methods

Deliverables:

- Downselected process approach
- Performance and reliability criteria met



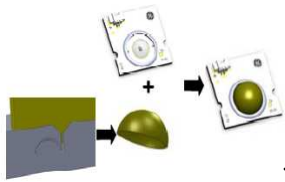
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Task-2

Task-3

Phosphor molding



OR

Slurry Coating



Phosphor molding selected

Milestone # 1

Long term **reliability tests** and **manufacturing scale up** of **Phosphor Molding**

Reliability testing



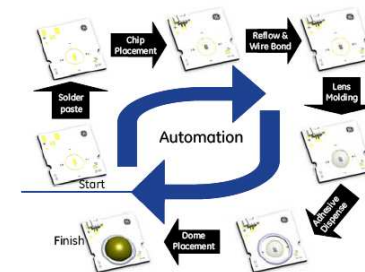
HTOL



RTOL

LM-80 Testing

Scale up



Milestone # 2

Adaptation into manuf. line

Task 3

Pilot downselected "Remote" Phosphor Manufacturing method

Deliverables:

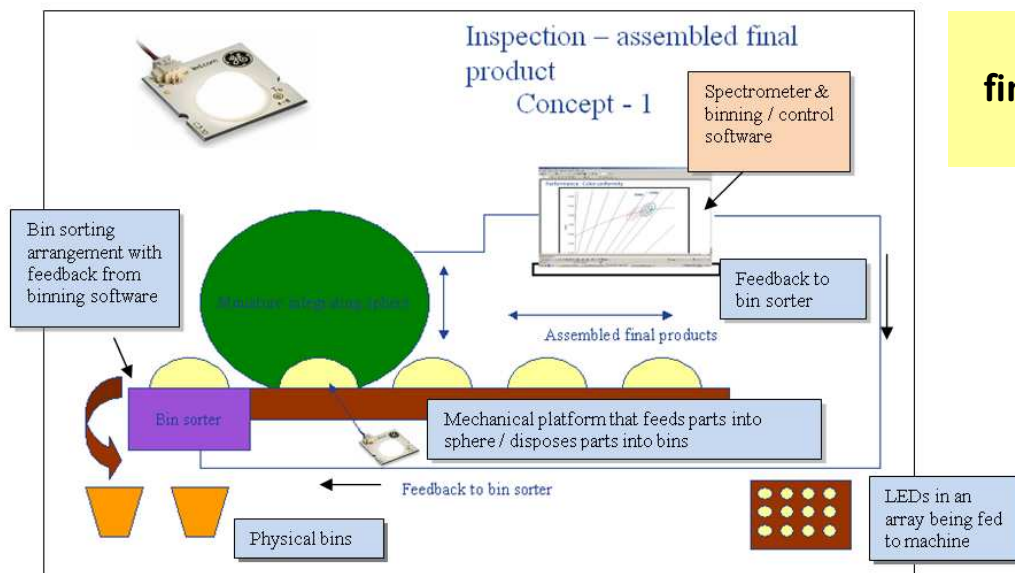
- Acceptable color variation established
- Performance and reliability criteria met
- Cost targets met



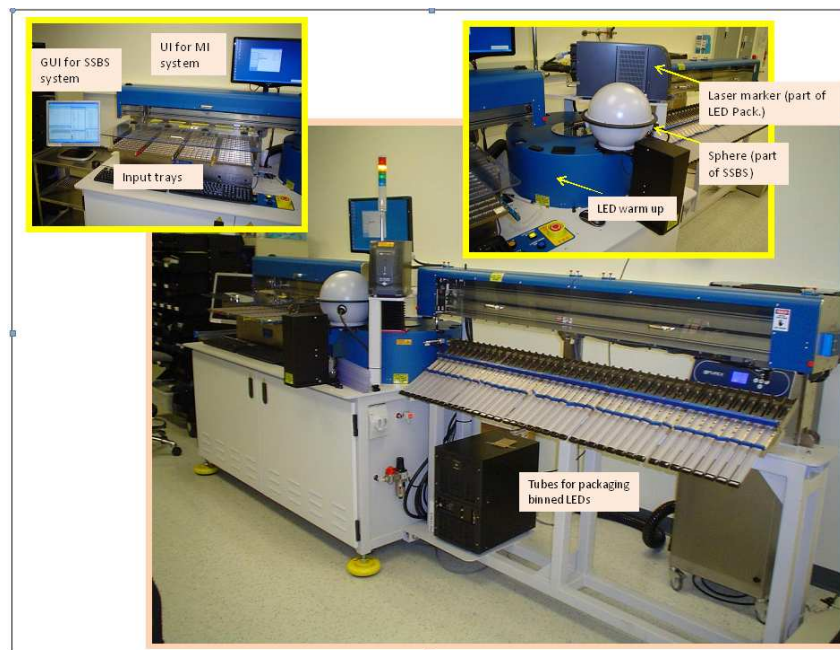
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Task-4



**Machine concepts
finalized, build started
in 2011**



**Machine build complete
in 2012**

Task 4

*Design & pilot high-speed characterization
techniques*

Deliverables"

- Establish measurement system capability
- Pilot measurement system with satisfactory GR&R



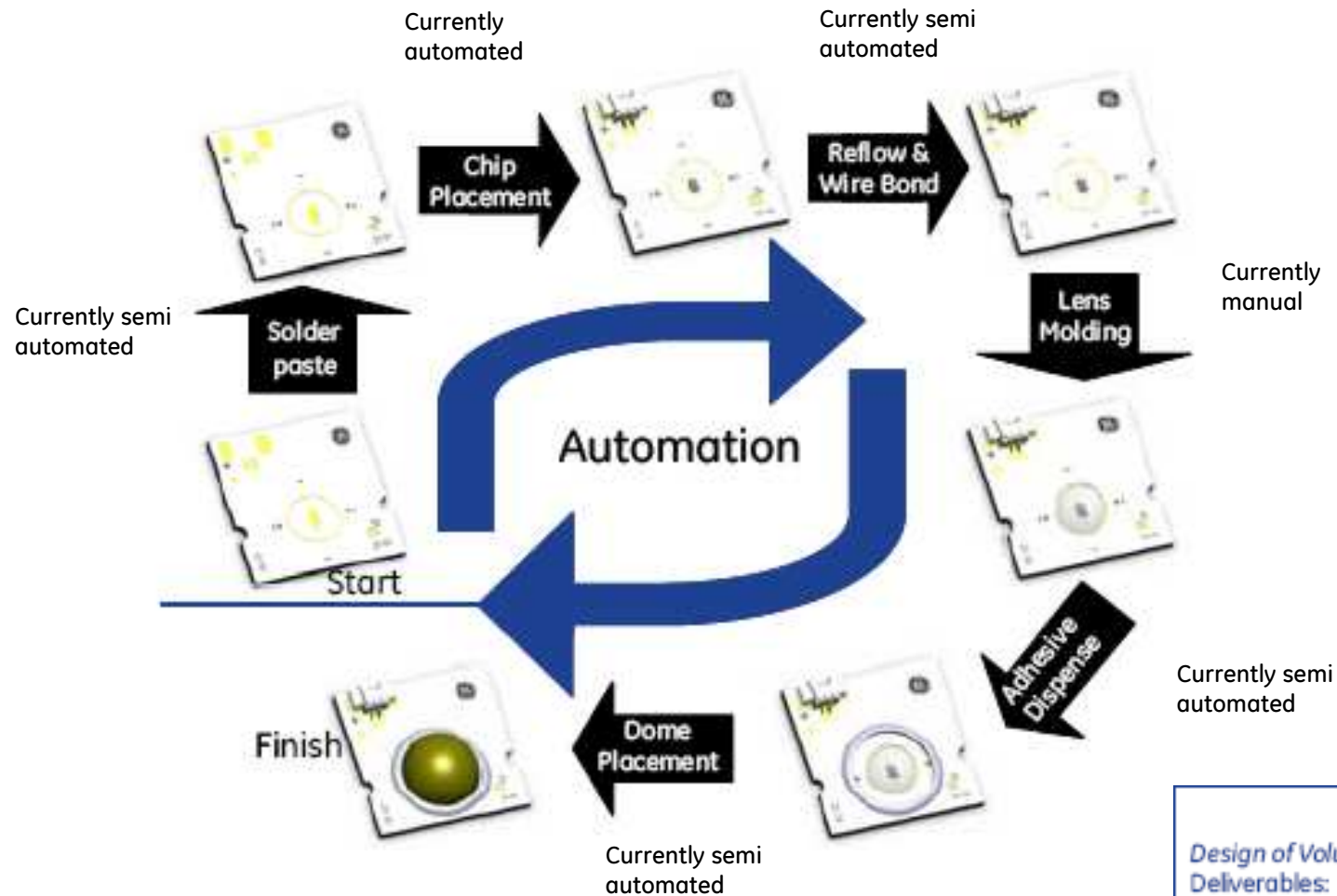
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Task-5

Design for large scale manufacturing line for Vio™

Go from a batch, manual process to a high speed line manufacturing process



Design created for future possible expansion

Task 5

Design of Volume Production Line

Deliverables:

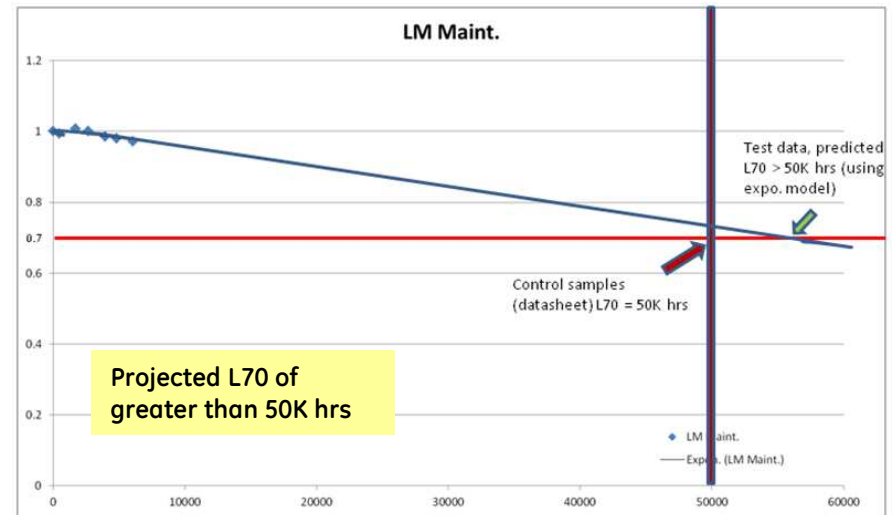
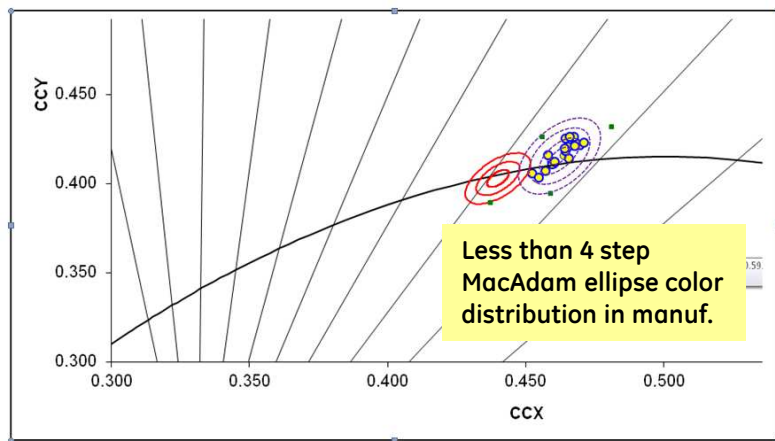
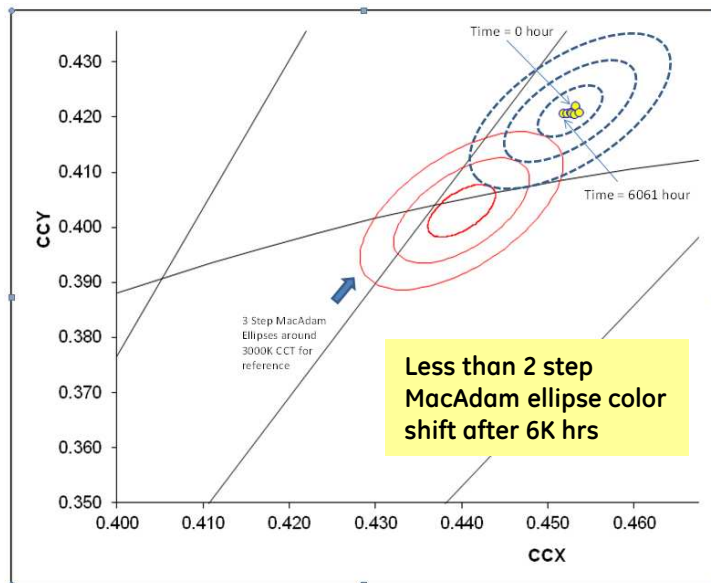
- Detailed large-scale manufacturing plan.
- Performance and reliability criteria met
- Cost targets met



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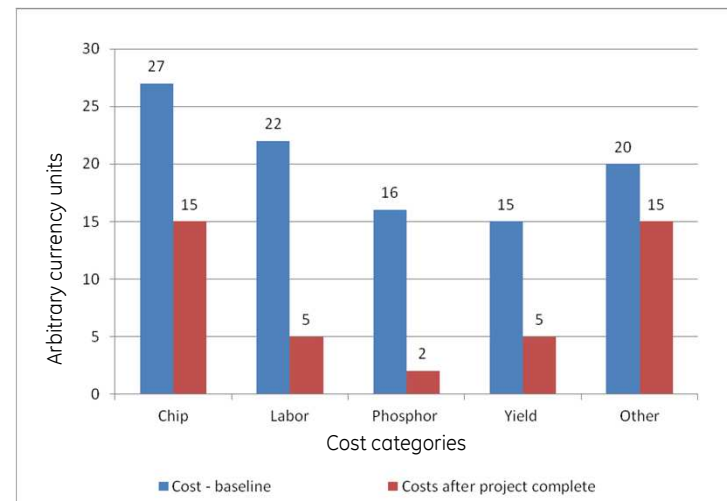
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Summary / Results



I (mA)	Vf	Iv (Lm)	CCX	CCY	CTEMP	CRI	LPW
350	18.27	604.1	0.3968	0.3895	3684	83	94.5

Able to achieve 90+ LPW in remote phosphor config. (using Blue LEDs)



Manuf. costs reduction target met



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